Heidrun Inverted Gas Lift System
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Agenda

• Background - Field and drainage techniques
• IGLS concept & qualification
• IGLS candidate well A-7
• IGLS installation
• Challenges
• Results
• Further work
Heidrun Field

- Mature oilfield
- Depleting reservoir pressure
- Sea- and produced water injection for reservoir pressure support
- Water break through and increasing water cut in most production wells
- 56 well slots
- 4 of 10 production wells *without* gas lift producing
- 26 of 29 production wells *with* gas lift producing
Heidrun Platform

- Tension Leg Platform (TLP)
- Casings landed in subsea wellhead
- Production risers
- Surface wellheads for landing production tubing and surface x-mas trees
- Producers with gas lift completed with dual tubing completion string
- Producers without gas lift completed with regular mono production tubing string
Barrier Envelopes

- 13 ⅜" casing secondary barrier between lift gas and environment
- Mono wells cased without gas tight connections in 13 ⅜" casing
Concept Selection

Concepts evaluated:

• 5 ½" tubing hanger in new spool below x-mas tree
• 5 ½" tubing hanger in new spool on top of x-mas tree
• Coiled tubing hanger in new spool on top of x-mas tree
• Coiled tubing hanger in new spool below x-mas tree
Selected Concept

- Standard Heidrun 7" mono XMT
- Install spool between WH and XMT
- Hang-off 1 ¾" CT in spool using Coiled Tubing Hanger (CTH)
- Shallow solution – injection point above the DHSV
- Lift gas down center of CTH and fluids produced through CT annulus and flow ports in CTH
Selected Concept

- XMT
- Spool piece
- Surface WH

- Spool piece / Coiled tubing hanger
- Surface wellhead
- Production riser
- Subsea wellhead
- DHHSV AVLDM SPM
- 22"
- 13 3/8"
- 9 5/8"
Qualification

• Re-design of lock-down mechanism after WCR – low differential pressure over CTH could release lock-down mechanism

• Stack-up test to verify design and new lock mechanism

• Yard test with full coiled tubing rig-up to verify concept
Well History IGLS candidate well 6507/7-A-7

• 1998 - Production start
• 2006 - Production stop - drowning
• 2008 - Successful test production for 1 month with gas lift at 513m MD (above DHSV) through temporary coiled tubing rig-up
• 2009 - Successful test production for 3 month with gas lift at 966m MD (below DHSV) through coiled tubing
• 2012 – 2014 - Gradual pressure increase resulting in on/off production of ~50% up-time until complete stop in 2014
Installation on Well A-7

- Independent of main drilling rig
- Intervention Tower for WL and CT-runs
- Rig crane to exchange XMTs
- Totally 22 days to install IGLS
  - Set deep pump open plug
  - Set shallow plug
  - Exchange XMTs and install spool
  - Pull shallow plug
  - Install coiled tubing
  - Pump open deep plug
Operational Challenges - Leak in CTH seals

• Failed leak test on CTH seals
  - Seals routing lift gas down coiled tubing
• Installed back-up CTH - also failed test
• Damage to seals - possible reason:
  - CTH ran through many ID changes in riser stack
  - Sharp edges in riser stack
  - Curl in coiled tubing pressing CTH into side
    (pipe straightener not applied)
Leak in CTH seals

• Obtained good seal by injecting sealing compound (thick grease) between seal pairs
• Uncertain how long seal will last
Operational Challenges - Stuck

- Not able to pass Safety head with CTH when pulling out to change to B/U CTH
- Lock ring on top of CTH
- Worked with Swab valve and annular BOP to centralize string
- Hung up in almost every ID change
Results

• Successfully installed IGLS
• Successfully demonstrated IGLS design functionality
• Identified several challenges and learning points for IGLS installations
• Well A-7 back on production
  - Oil: 210 Sm³/day - 1320 bbl/day
  - Water: 1468 Sm³/day - 9233 bbl/day
  - Gas: 31 462 Sm³/day - 1111 Mscf/day
Further work

- Identify further IGLS candidates on Heidrun
- Before next installation
  - Review and compare operation, design and learning points from the parallel IGLS installation on Statfjord field
  - Investigate damage to CTH seals and identify actions to remove problem for next installation
  - Review operation efficiency and identify improvement potential
Heidrun Inverted Gas Lift System

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